IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 8 Ser. 7 (August. 2024), PP 35-38
www.iosrjournals.org

Understanding Torque: A Key To Precision In Orthodontics": A Narrative Review

Dr. Sandeep Kumar Verma[1], Dr. Priyank Rai[2], Dr. Anshika Gandhi[3]
[1](Department Of Orthodontics And Dentofacial Orthopedics, Maulana Azad Institute Of Dental Sciences, New Delhi, India)
[2](Department Of Orthodontics And Dentofacial Orthopedics, Maulana Azad Institute Of Dental Sciences, New Delhi, India)
[3](Department Of Orthodontics And Dentofacial Orthopedics, Maulana Azad Institute Of Dental Sciences, New Delhi, India)

Abstract:
Background *Torque in orthodontics is a critical biomechanical factor that influences the positioning and angulation of teeth within the dental arch. This rotational force, applied through various orthodontic appliances, plays a vital role in achieving accurate tooth alignment and optimal occlusion. The application of torque involves both the angulation of the roots and the corresponding adjustments in the brackets and archwires to ensure that teeth move into their desired positions while maintaining functional harmony. This article reviews the principles of torque, including its definition, application techniques, and clinical significance. It highlights the various methods used to apply and control torque, such as bracket design, wire adjustments, and the impact of patient-specific anatomical variations. Challenges associated with achieving precise torque are discussed, including the influence of tooth size, root morphology, and treatment goals. By understanding and effectively managing torque, orthodontists can improve treatment outcomes, enhance esthetic results, and reduce the risk of relapse. This review aims to provide a comprehensive overview of torque in orthodontics, emphasizing its importance in contemporary orthodontic practice and its role in advancing treatment methodologies.*
Key Word*: Orthodontics; torque, buccolingual inclination, esthetics*

Date of Submission: 15-08-2024 Date of Acceptance: 25-08-2024

I. Introduction

Torque is the force that allows an orthodontist to manage the axial inclinations of teeth and position them optimally for a well-finished result. It provides control over the movement of tooth roots. Without a proper understanding of torque, an orthodontist may encounter numerous problematic tooth movements, which can complicate the treatment process and lead to less satisfactory results.[1] As one reviews the literature, it becomes evident that one of the most frequently encountered problems is the reduction of the difference between the angles SNA and SNB. To achieve this reduction, bodily movement of the anterior teeth is necessary. This cannot be accomplished without proper application of torque force. According to Holdaway[2], when aiming to reorient the apical base, it is crucial to maintain a proper labial axial inclination of the upper incisors. This approach is beneficial because moving these teeth bodily results in a more significant reduction in the SNA angle compared to just tipping them lingually. The objective of this article is to review the importance of torque in orthodontics and provide a brief description about torque in different appliance systems.

Importance Of Torque

- Proper reduction of bimaxillary protrusion
- Proper alignment of extremely crowded teeth.
- Optimal correction of extreme deep bite which requires maximum anchorage consideration and maximum anterior crown tipping.
- Normal axial inclination provides successful correction of class II molar relation
- Proper anterior guidance during mandible excursions and proper food deflection
- To maintain the health of the teeth and the surrounding structures
- Fullness of the smile should be sought through adjustment of the clinical crown torque of the maxillary canines and premolars to their most esthetic appearance in different face types.[3]

II. Discussion

Torque with the edgewise appliance

The edgewise mechanism significantly aids in achieving orthodontic treatment goals by allowing precise control over the axial inclination of each tooth in every direction. This is achieved by engaging the arch wire within the bracket slot on each tooth.[14] The Edgewise system applies torque to the teeth buccally or lingually by using an activated rectangular wire in a rectangular bracket slot.[5] However, adjacent teeth experience equal and opposite forces, which are often overlooked, leading to a reduction in the facio-lingual discrepancy between neighboring teeth. Rectangular arch wires with twists are typically used when reciprocal torque is needed for adjacent teeth, but they can cause high moments in full-sized or nearly full-sized stainless-steel arch wires.[6] This issue can be addressed by using undersized wires for torque, employing torquing arches that apply concurrent third-order couples to multiple incisors as if they were a single unit, and including a second bracket at the molar for this two-couple system. Additionally, incorporating torquing spurs in round-base arch wires and using Warren springs can help mitigate the problems associated with edgewise appliance torque. Proper torque control during the finishing stages can also be achieved by maintaining the correct moment-to-force ratio during retraction in extraction cases.[7] The original edgewise bracket design, which had a slot cut perpendicular to the base, required twisting the rectangular arch wire to achieve correct crown-root inclinations. To address this, torqued slot brackets were introduced by manufacturers in the late 1950s or early 1960s, eliminating the need for additional torque in the anterior portion of the upper arch wire.[8]

Torquing with begg's and refined begg's appliance

Pre-adjusted edgewise appliances are inherently capable of precise finishing and achieving an aesthetically pleasing result for teeth. This contrasts with the classic Begg appliance, which uses round archwires in Begg brackets.[9] Preadjusted brackets provide three-dimensional control over the dentition through the use of rectangular wires fitting into rectangular slots. Rectangular finishing wires have the added benefit of applying torque to posterior teeth.[10] While individual posterior teeth can be torqued with Begg auxiliaries, applying torque to multiple or all posterior teeth is more challenging with round base wires.

In the final phase of treatment, torque adjustments are made by slightly over-torquing and over-tipping the roots of all teeth by 10-15%. This approach allows the roots to settle into their correct positions and torque during finishing. Anterior root torque, which includes palatal movement of the maxillary central incisor roots and the distal and palatal movement of the maxillary lateral incisors, is commonly referred to as just torque.[11] Several auxiliaries have been developed to achieve these movements, with the spur type auxiliaries, which can have either two or four spurs, being among the most frequently used. Reactions to torque auxiliaries typically include depressions and flaring of the maxillary buccal segments.[12] According to Swain, the depression of the buccal segments is a direct response to the palatal root movement of the maxillary central incisors, while flaring is due to the torque applied to the maxillary lateral incisors. The wing type auxiliary, on the other hand, causes expansion in the cuspid area.[13] Spur type torquing auxiliary

The spur-type torquing auxiliary for the maxillary incisors is typically made from 0.014" diameter wire and features torquing spurs or projections that contact the labial surfaces of the teeth at the center of their crowns.[15] The basic design, which includes two spurs, can be expanded to four or even six spurs to facilitate the palatal movement of the roots of the lateral incisors and canines, depending on the goals of the third stage of treatment. The optimal torquing force is generally around 55 grams of pressure, and a monthly lingual movement of the roots by four degrees indicates effective application of the root-torquing force.[16] If only the roots of the central incisors need to be torqued, a two-spur auxiliary is used.

Torque control in tip edge

This process is performed during the final stage of treatment.Torque is applied to the roots of the maxillary incisors using nickel titanium torque bars.These bars are curved ribbon arch sections measuring 0.022 - 0.018 inches with a 30-degree torque. They are nearly invisible when in use because they are positioned directly behind the archwire.Special Deep Groove Brackets are required for the torque bars on the maxillary central incisors.These brackets include conventional preadjusted Edgewise archwire slots integrated into the base of the Tip Edge archwire slots.[19] A cap covers the Deep Groove during Stages One and Two.At the start of Stage Three, this cap is removed, and a torque bar is tightly ligated lingually to the round base archwire.For individual tooth torquing, an Individual Root Torquing Auxiliary is employed. These auxiliaries are frequently used with Ceramic Tip Edge brackets, which lack the Deep Groove feature.[20]

Torque control in lingual orthodontics

Achieving accurate torque control with lingual appliances is notably challenging due to factors such as reduced arch radius, shorter interbracket distances, complex lingual geometry, highly variable tooth shapes, and limited access and visibility.[21] With lingual brackets, early torque control becomes crucial, as even minor

variations in the labiolingual inclinations of the incisors can lead to noticeable height differences.The TARG (Torque and Angulation Reference Guide) is a tool designed to transfer bracket prescriptions from the more reliable labial surfaces of the teeth to the lingual surfaces at the appropriate bracket height. Essentially, this method allows for a diagnostic setup without having to section the model, enabling laboratory technicians to set customized torque and angulations according to each prescription.[22] For instance, a Class II, Division 2 case requiring additional torque for the maxillary anteriors will be noted on the prescription. The technician then adjusts the TARG to set the prescribed torque, positioning the lingual bracket at a higher torque angle compared to average bracket values, and compensates for the fit of the lingual bracket base with Advance adhesive.[23]

Special considerations are required for torquing the maxillary and mandibular anterior teeth:
1. Use of a Torquing Auxiliary: Similar to those used in conventional Begg mechanotherapy, where the force is applied at the incisal edge of the tooth.
2. Use of a Torqued Ribbon Arch: This provides around 45 degrees of torque for mandibular anterior teeth and 30 degrees for maxillary anterior teeth. When the ribbon arch extends past the cuspid-bicuspid area, it naturally transitions to approximately 90 degrees for the buccal segments. Materials such as beta titanium, stainless steel, and Elgiloy rectangular wire can also be effective for this purpose.

Hocevar[24] has noted that the ribbon arch is particularly effective for torquing maxillary anterior teeth and offers the advantage of applying more gentle forces in the buccolingual directions, which is a significant benefit in lingual orthodontic treatment.

Torque control bioprogressive treatment

Bioprogressive therapy[25] proposes that efficient tooth movement and effective treatment procedures can be achieved with precise control over the direction of root movements.
There are four key treatment scenarios where controlling root torque is essential:
1. Maintaining Roots in Vascular Trabecular Bone
- For effective tooth movement, such as incisor intrusion or cuspid retraction, torque control helps direct the roots away from the denser, thicker cortical bone and into the less dense, vascular trabecular bone.
- For example, the lower incisors, which are supported by the lingual cortical bone, require buccal root torque to facilitate their efficient intrusion through the trabecular bone.

2. Positioning Roots Against Dense Cortical Bone
- This is important for providing anchorage during treatment.

3. Using Torque to Remodel Cortical Bone:
- Certain tooth movements necessitate placing the roots into dense, less vascular cortical bone. This includes movements such as incisor retraction, upper incisor root torquing, correcting impacted upper canines, and moving lower molars forward to close spaces left by missing or extracted teeth.[26]

4. Applying Torque for Final Occlusion Details:
- For ensuring proper function and improved stability of the final occlusion.

Torquing with removable appliances

Many straightforward malocclusions can be addressed with removable appliances. However, because these appliances only move the crowns of the teeth, they cannot achieve root torque, especially in cases where there is spacing among the anterior teeth. Although removable appliances can effectively close spaces, they often result in labial root prominence of the anterior teeth by the end of treatment.[27,28]

To overcome this issue and reduce the need for a fixed appliance for correction, a new technique for root tipping of anterior teeth with removable appliances was developed. This method involves constructing a removable appliance in a traditional manner, using Adams clasps on the first permanent molars and triangular clasps between the first and second premolars for added anchorage and to counteract leverage in the anterior region.[29,30]

The labial bow is made from 0.7mm Dentaurum wire. After curing the plastic, a fine file is used to mark the midline of the labial bow. A small (0.6mm) wire lug is then soldered to this mark, being careful not to anneal the labial wire. A torquing spring is created using 0.4mm spring wire, starting the winding from the central lug and forming lingually inclined loops. The distal ends of the loops are not soldered to the labial bow, with force generated from the central lug resisting loop activation.[31]

When the appliance is fitted, the loops apply pressure to the cervical third of the crown, while the labial bow prevents the crown from tipping labially, restricting movement to lingual root tipping. This technique may vary in effectiveness between adults with alveolar bone loss and adolescents.

For adults, a thin arch is preferred for torque movement, as light wire torque can potentially lead to root resorption if applied continuously over a long period.[32,33] To minimize root resorption, it is best to use light torquing forces applied intermittently over a relatively short distance.

Torque with clear plastic appliances

Clear plastic tooth-moving appliances are ideal for patients with mild to moderate alignment issues who are hesitant to use fixed appliances.[34,35] The Essix tooth movement system uses a thin, durable, and nearly invisible removable plastic appliance. Compared to edgewise brackets, Essix appliances offer greater efficiency in achieving torque. This is because the limitation in torque effectiveness is based on the clinical crown length, measured in millimeters, rather than the width of a rectangular bracket slot, which is measured in thousandths of an inch.[36,37] Torque is applied by creating force-inducing projections in the plastic using Hilliard Thermo-pliers or composite molding on both the labial and lingual sides of the target tooth simultaneously. Additionally, a block-out material is applied by the clinician on the cast to facilitate tooth movement.

III. Conclusion

Torque has been termed a forbidden and dangerous force by many operators, however with proper understanding and with a systematic, technical approach, torque is not difficult to accomplish.

The operator's ability to control torque properly will mean the difference between an artistically treated case that has all the esthetic beauty desired in the finished denture and an ordinary tooth-straightening accomplishment that contains very few of these desirable features

References

[1] Rauch Ed. Torque And Its Application To Orthodontics. American Journal Of Orthodontics. 1959 Nov 1;45(11):817-30.
[2] Holdaway, R. A.: Changes In Relationship Of Points A And B, Am. J. Orthodontics 42: 176-193, 1956
[3] Zachrisson Bu. Making The Premolar Extraction Smile Full And Radiant. World J Orthod. 2002;3:260-5
[4] Thicket E, Taylor Ng, Hodge T. Choosing A Pre-Adjusted Orthodontic Appliance Prescription For Anterior Teeth. J Orthod. 2007;34:95-100
[5] Thurow Rc. Edgewise Orthodontics. 4th Ed. St Louis, Mo: Cv Mosby Co; 1982. P39
[6] Isaacson Rj, Lindauer Sj, Rubenstein Lk. Moments With The Edgewise Appliance: Incisor Torque Control. Am J Orthod Dentofacial Orthop. 1993;103:428-38.
[7] Bernstein L. Root Torque With Warren Springs. J Clin Orthod. 1971;5(3):167-9.
[8] Nanda Rs. Biomechanics And Esthetic Strategies In Clinical Orthodontics. St Louis, Mo: Elsevier Saunders; 2005. P120.
[9] Graber Tm, Swain Bf. Orthodontics: Current Principles And Techniques. St Louis: Cv Mosby; 1985. P717.
[10] Kapur-Wadhwa R. Physical And Mechanical Properties Affecting Torque Control. Journal Of Clinical Orthodontics: Jco. 2004 Jun;38(6):335-4. Hurd Jj, Nikolai Rj : Am J Orthod 1976; 70: 551-558.
[11] Mulligan Tf. Common Sense Mechanics. 3. Journal Of Clinical Orthodontics: Jco. 1979 Nov 1;13(11):762-6.
[12] Burstone Cj, Pryputniewicz Rj. Holographic Determination Of Centers Of Rotation Produced By Orthodontic Forces. American Journal Of Orthodontics. 1980 Apr 1;77(4):396-409. Smith Rj, Burstone Cj : Am J Orthod 1984; 77: 396-409
[13] Nahoum Hi. Torque: A Round Wire Technique. The Angle Orthodontist. 1962 Oct 1;32(4):242-51.
[14] Strang Rh. A Discussion Of Torque Force As Available In The Edgewise Arch Mechanism. The Angle Orthodontist. 1932 Apr 1;2(2):88-111. Brodie, Allan G. : Angle Orthodontist: 1933: Vol. 3, No. 4, Pp. 263–265.
[15] Kusy Rp. Influence Of Force Systems On Archwire-Bracket Combinations. American Journal Of Orthodontics And Dentofacial Orthopedics. 2005 Mar 1;127(3):333-42. Nanda R. Biomechanics In Clinical Orthodontics. 2nd Edition, 1997.
[16] Graber Tm, Vanarsdall Rl, Vig K. Current Principles And Techniques. Orthodontic Book, Usa. 2005:607-11.
[17] Lindauer Sj. The Basics Of Orthodontic Mechanics. Inseminars In Orthodontics 2001 Mar 1 (Vol. 7, No. 1, Pp. 2-15). Wb Saunders.
[18] Lindauer Sj, Isaacson Rj, Brilto Ad. Three-Dimensional Force Systems From Activated Orthodontic Appliances. Inseminars In Orthodontics 2001 Sep 1 (Vol. 7, No. 3, Pp. 207-214). Wb Saunders.
[19] Gioka C, Eliades T. Materials-Induced Variation In The Torque Expression Of Preadjusted Appliances. American Journal Of Orthodontics And Dentofacial Orthopedics. 2004 Mar 1;125(3):323-8.
[20] Siatkowski Re. En Masse Space Closure With Preciseanchorage Control. Inseminars In Orthodontics 2001 Sep 1 (Vol. 7, No. 3, Pp. 141-149). Wb Saunders.
[21] Proffit Wr, Fields H, Larson B, Sarver Dm. Contemporary Orthodontics-E-Book: Contemporary Orthodontics-E-Book. Elsevier Health Sciences; 2018 Aug 6.
[22] Vardimon Ad, Oren E, Ben-Bassat Y. Ajodo 1998 Nov;114(5) Page:520-9.
[23] Isaacson Rj, Lindauer Sj, Rubenstein Lk., Ajodo 1993 May;103(5)
[24] Hk V, Nayak Rs, Pasha A. Finishing And Detailing In Orthodontics: A Short Review.
[25] Bench Rw, Gugino Cf, Hilgers Jj. Bio-Progressive Therapy. Journal Of Clinical Orthodontics: Jco. 1977 Sep;11(9):616-27.
[26] Owen Iii Ah. The Maxillary Sagittal Appliance: A Clinical Study. American Journal Of Orthodontics And Dentofacial Orthopedics. 1987 Apr 1;91(4):271-85.
[27] Vaden Jl. Charles H. Tweed, 1895-1970. American Journal Of Orthodontics And Dentofacial Orthopedics. 2015 May 1;147(5):S171-9..
[28] Mclaughlin Rp, Bennett Jc, Trevisi Hj. Systemized Orthodontic Treatment Mechanics.
[29] Goldin B. Labial Root Torque: Effect On The Maxilla And Incisor Root Apex. American Journal Of Orthodontics And Dentofacial Orthopedics. 1989 Mar 1;95(3):208-19.
[30] Wainwright Wm. Faciolingual Tooth Movement: Its Influence On The Root And Cortical Plate. American Journal Of Orthodontics. 1973 Sep 1;64(3):278-302.
[31] Van Steenbergen E, Burstone Cj, Prahl-Andersen B, Aartman Ih. Influence Of Buccal Segment Size On Prevention Of Side Effects From Incisor Intrusion. American Journal Of Orthodontics And Dentofacial Orthopedics. 2006 May 1;129(5):658-65.